

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 September 2001 (07.09.2001)

PCT

(10) International Publication Number
WO 01/65112 A1

(51) International Patent Classification⁷: F03B 13/24

(21) International Application Number: PCT/GB01/01012

(22) International Filing Date: 28 February 2001 (28.02.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0004940.3 2 March 2000 (02.03.2000) GB

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,

DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

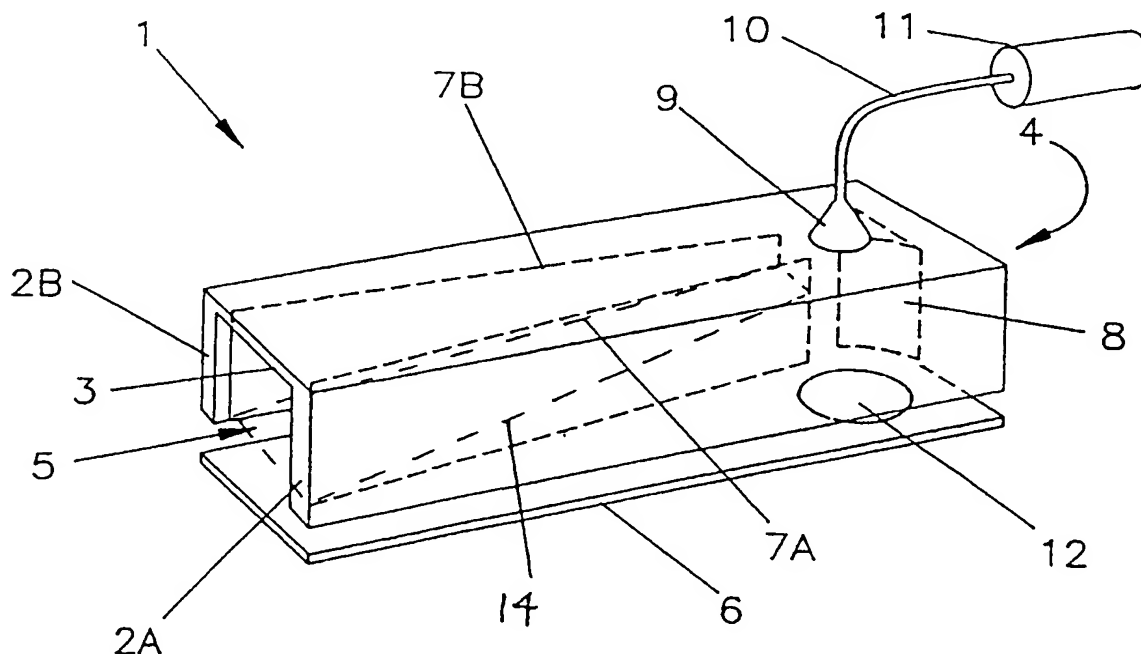
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS FOR DERIVING ENERGY FROM WAVES



(57) Abstract: Apparatus for deriving energy from waves, the apparatus comprising a chamber (1) adapted to float in water but having a water plane area such that its vertical oscillating movement is substantially damped relative to the height of waves in the water in which it is floating, a chamber inlet port (5) at one end of the chamber adapted to face into a wavetrain, and vertical side plates (7A, 7B) delivering compressed air to a manifold and thence to an outlet port (9) and a baffle (8).

Title: Apparatus for deriving energy from waves

5 The present invention relates to an apparatus for deriving energy from waves, particularly waves in the sea.

 Devices for deriving energy from sea waves are known. Many of these devices use the vertical motion of waves to drive an oscillating column of air through a self-rectifying
10 turbine. In other cases, waves are induced to break and the water channelled upwards to replenish continuously an elevated reservoir. Most devices are sited on the shoreline or on the sea bed, and the construction needs to be very substantial to cope with the forces produced by the waves.

15 The invention seeks to derive energy from waves in a different manner by using the forward motion of a wave to compress the air between two wave peaks.

 According to the present invention there is provided an apparatus for deriving energy from waves comprising a chamber adapted to float in water but having a water
20 plane area such that its vertical oscillating movement is substantially damped relative to the height of waves in the water in which it is floating, a chamber inlet port at one end of the chamber adapted to face into a wavetrain, and vertical side plates delivering compressed air to a manifold and thence to an outlet port and a baffle.

25 In use waves travel through the inlet port and compress air in the wave troughs as each wave advances into the manifold and then hits the baffle whereby the compressed air is forced out of the outlet port to provide a source of energy.

Preferably the chamber is an elongate chamber.

5

The chamber may be formed from a pair of side walls spaced apart by a top plate.

One end of the side walls may be joined by an end wall and the other end of the side walls are spaced to provide the inlet port.

10

A bottom plate may span the side walls and the side walls may provide at least part of the buoyancy for the chamber.

15 The baffle may be provided adjacent the end wall, or the baffle may be provided by the end wall itself.

The baffle may taper towards the inlet port.

20 The chamber may include a pair of tapering side plates adjacent each side wall to compress the air entering in successive wave troughs.

The angle of taper of the side plates may be adjustable and they may be curved.

25 An internal ramp may be provided to form a base for the wave channel.

Preferably the compressed air outlet port is adjacent the baffle and the outlet may be mounted in the upper section of the compression manifold..

A wave water outlet may be provided in the chamber and may be adjacent the
5 baffle.

Means may be provided to adjust the buoyancy of the chamber to adjust its height
in the water to suit different wave conditions.

10 An embodiment of the present invention will now be described, by way of
example, with reference to the accompanying drawings in which:

Figure 1 shows a perspective view,

Figure 2A shows a diagrammatic cross section view of waves in the chamber prior
to air being compressed, and

15 Figure 2B shows a diagrammatic cross section view of waves in the chamber with
air compressed.

Referring to Figure 1 there is shown an apparatus for deriving energy from waves.
The apparatus has an elongate chamber 1 adapted to float in water. Chamber 1 is formed
20 from a pair of side walls 2A, 2B spaced apart by a top plate 3. One end of the side walls
are joined by an end wall 4 and the other end of side walls are spaced to provide an inlet
port 5. A bottom plate 6 may span the edges of the side walls opposite the top plate 3.

Chamber 1 includes a pair of internal tapering side plates 7A, 7B (shown in dotted
25 lines) adjacent each side wall 2A, 2B to compress laterally the air in a wave trough and
deliver the compressed air to a manifold 15. The bottom of the channel may be the plate 6
or an inclined ramp 14.

A baffle 8 has the double function of restricting egress of air from the compression manifold 15 and dispersing remnant wave energy so that it is not reflected back along the chamber to interfere with the next incoming wave. The tapered sides of the baffle may be curved as shown.

An air outlet port 9 is mounted on the top plate 3 to which is attached an airflow pipe 10 connected to a prime mover 11. Outlet port 9 is in the compression manifold 15 adjacent the baffle, and between the baffle and the inlet port. Wave water outlets 12 are provided in the side walls 2A, 2B adjacent the baffle 8.

Referring now to Figures 2A, 2B it will be seen that the chamber 1 may be anchored to the sea bed by anchor and chain 13. The chamber is tethered from the inlet port so that the inlet port always faces the wavetrain.

Buoyancy for the chamber 1 is provided mostly by the side walls 2A, 2B, but also by the end wall 4. The side and end walls have a small water plane area such that the vertical oscillating movement of chamber 1 is substantially damped relative to the height of waves in the water in which it is floating,

In use waves travel through the inlet port and travel along the wave channel created by the side plates 7A, 7B towards the compression manifold 15 and the baffle 8. As seen in Figure 2A a volume of air Z (in the trough behind a peak of wave X hitting the baffle and the following peak of wave Y) is fed into the manifold 15 under the outlet port 9. As wave Y moves towards baffle 8, the volume of air Z is compressed into the

manifold by the wave Y and forced out through the outlet port 9. Each wave hitting the
5 baffle 8 is reflected normal to the direction of the wave train to disperse the wave energy,
and excess water under pressure passes through water outlet 12.

It will be appreciated that the air between any two waves entering the chamber 1
will be compressed in the manifold 15 and expelled through the aperture 9. The
10 compressed air may be used to drive a prime mover 11 designed to generate energy. A
non-return valve (not shown) may be positioned in the pipe 10 to take off air when it
reaches a designated compression.

The invention may take a form different to that specifically described above. In
15 particular the apparatus may be adjustable to suit different wave conditions. For example
means may be provided to adjust the buoyancy of the chamber to adjust its height in the
water to suit different wave heights, or means may be provided to adjust the angle of taper
of the side plates 7A, 7B. It is thought that the taper of the side plates 7A, 7B may help to
compress the air to increase the peak pressure of air driven out through the outlet port 9,
20 and adjustment of the taper of plates 7A, 7B may serve to give compression ratios of e.g.
between 2:1 to 6:1. The position of baffle 8 may be adjustable along the length of chamber
1, e.g. to suit different wavelengths. The bottom plate 6, or the ramp 14, may also be
angled, and possibly adjustable like the side plates, to help compress the air.

25 Also the apparatus may be of a simpler construction. For example the side walls
2A, 2B may serve as a wave channel guide and the side plates 7A, 7B may not be required.
The bottom plate 6 may not be required and the end wall 4 may serve as the baffle instead
of there being a separate baffle.

It is envisaged that the apparatus of the invention may be produced in different
5 sizes to suit different types of conditions, e.g. for estuary use or for ocean use. The prime
mover 11 may generate electricity. Also two or more such apparatus may be
interconnected to supply a single source of compressed air to a prime mover. The prime
mover may be positioned on or remote from any chamber 1.

10 It is also envisaged that two similar apparatus may be connected back to back,
possibly with a baffle unit in common, so that one delivers compressed air to a reservoir
and the other extracts air to create a partial vacuum in a second reservoir. A prime mover
may then be powered by the difference in pressure between the two reservoirs.

15 Because the chamber 1 may be anchored to the sea bed, the force on the chamber 1
is greatly reduced compared to hitherto known fixed constructions.

CLAIMS

- 5 1. Apparatus for deriving energy from waves, the apparatus comprising a chamber adapted to float in water but having a water plane area such that its vertical oscillating movement is substantially damped relative to the height of waves in the water in which it is floating, a chamber inlet port at one end of the chamber adapted to face into a wavetrain, a baffle in the chamber, and vertical side plates delivering compressed air to a manifold
10 and thence to an outlet port and a baffle.
2. Apparatus as claimed in claim 1, in which, in use, waves travel through the inlet port and compress air in the wave troughs as each wave advances into the manifold and then hits the baffle whereby the compressed air is forced out of the outlet port to provide a
15 source of energy.
3. Apparatus as claimed in claim 1 or claim 2, in which the chamber is an elongate chamber.
- 20 4. Apparatus as claimed in any preceding claim, in which the chamber is formed from a pair of side walls spaced apart by a top plate.
5. Apparatus as claimed in claim 4, in which one end of the side walls is joined by an end wall and the other end of the side walls are spaced to provide the inlet port.
25
6. Apparatus as claimed in claim 5, in which a bottom plate spans the side walls and the side walls provide at least part of the buoyancy for the chamber.

7. Apparatus as claimed in claim 5 or claim 6, in which the baffle is provided adjacent
5 the end wall.

8. Apparatus as claimed in any preceding claim, in which the baffle tapers towards the
inlet port.

10 9. Apparatus as claimed in any preceding claim, in which the chamber includes a pair
of tapering side plates adjacent each side wall to compress the air entering in successive
wave troughs.

10. Apparatus as claimed in claim 9, in which the angle of taper of the side plates is
15 adjustable.

11. Apparatus as claimed in any preceding, in which an internal ramp is provided
between the inlet port and the manifold.

20 12. Apparatus as claimed in claim 11, in which the angle of the ramp is adjustable.

13. Apparatus as claimed in any preceding claim, in which the air outlet port leads off
the manifold adjacent the baffle.

25 14. Apparatus as claimed in any preceding claim, in which a wave water outlet is
provided in the chamber adjacent the baffle.

15 Apparatus as claimed in any preceding claim, in which means are provided to
5 adjust the buoyancy of the chamber to adjust its height in the water to suit different wave
 conditions.

16. Apparatus for deriving energy from waves substantially as hereinbefore described
 with reference to and as shown in the accompanying drawings.

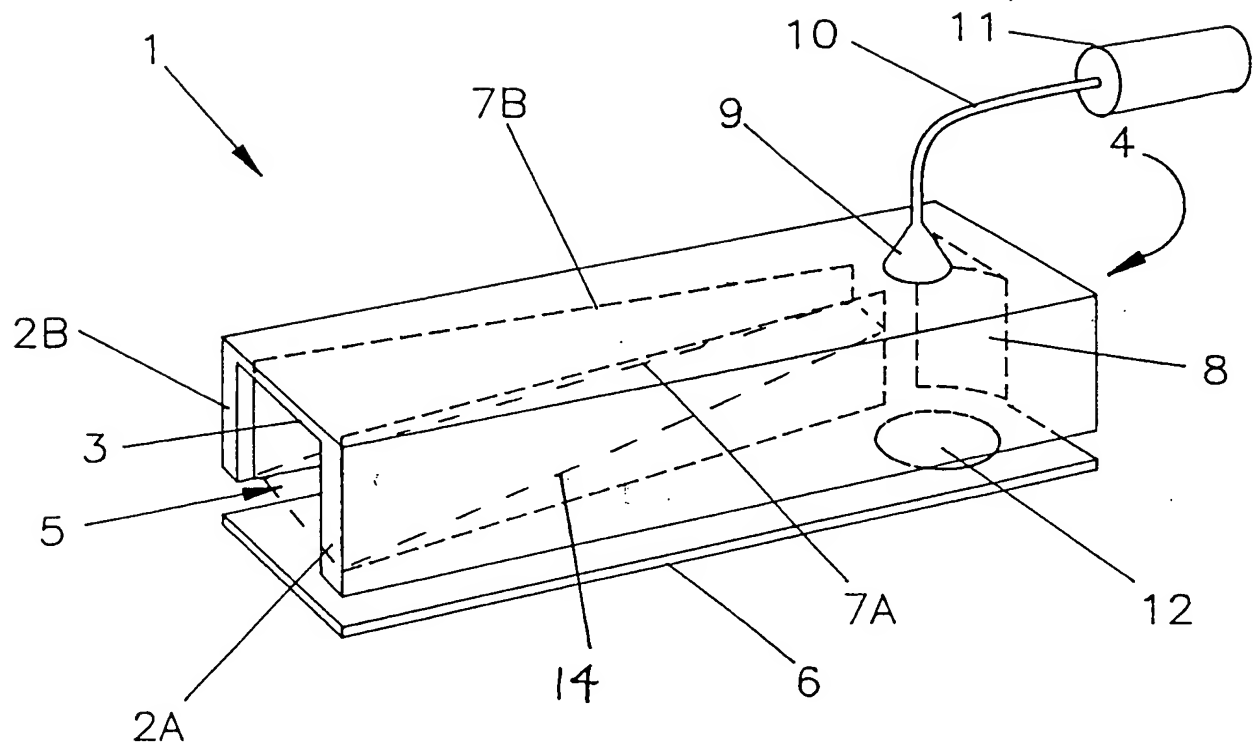
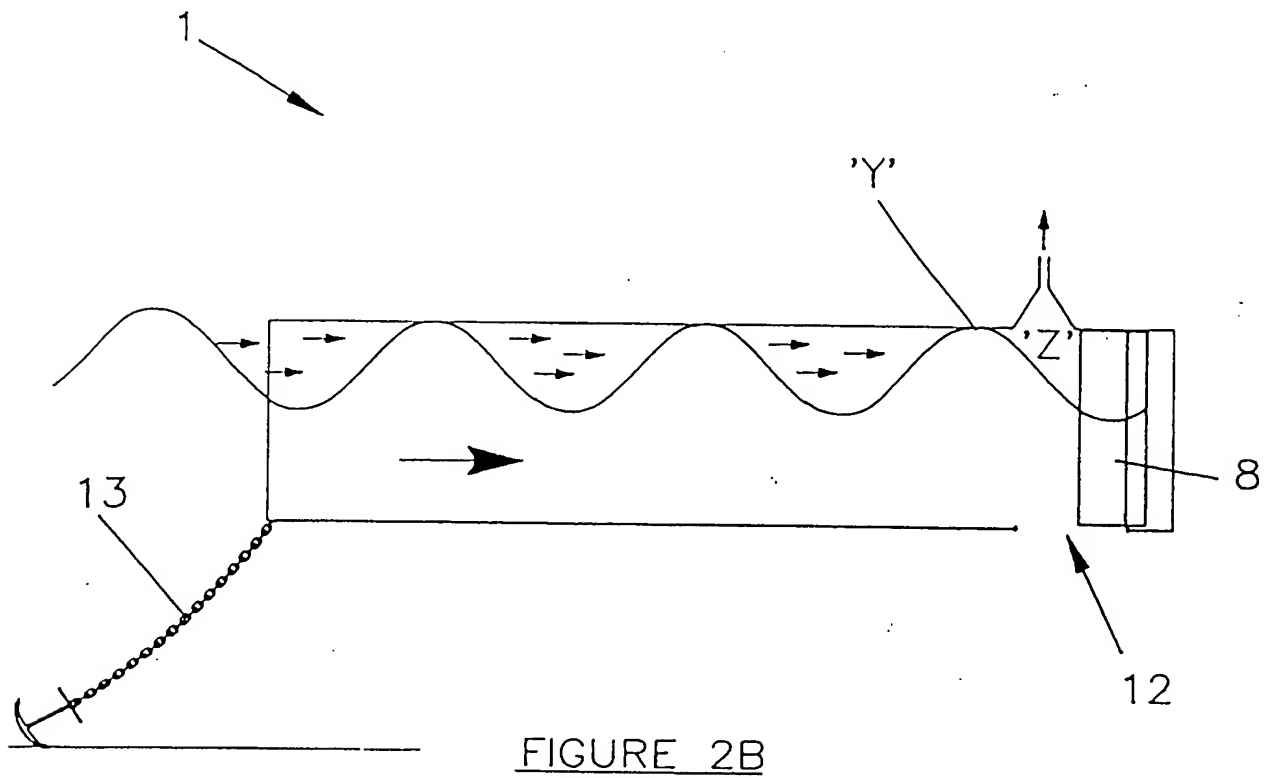
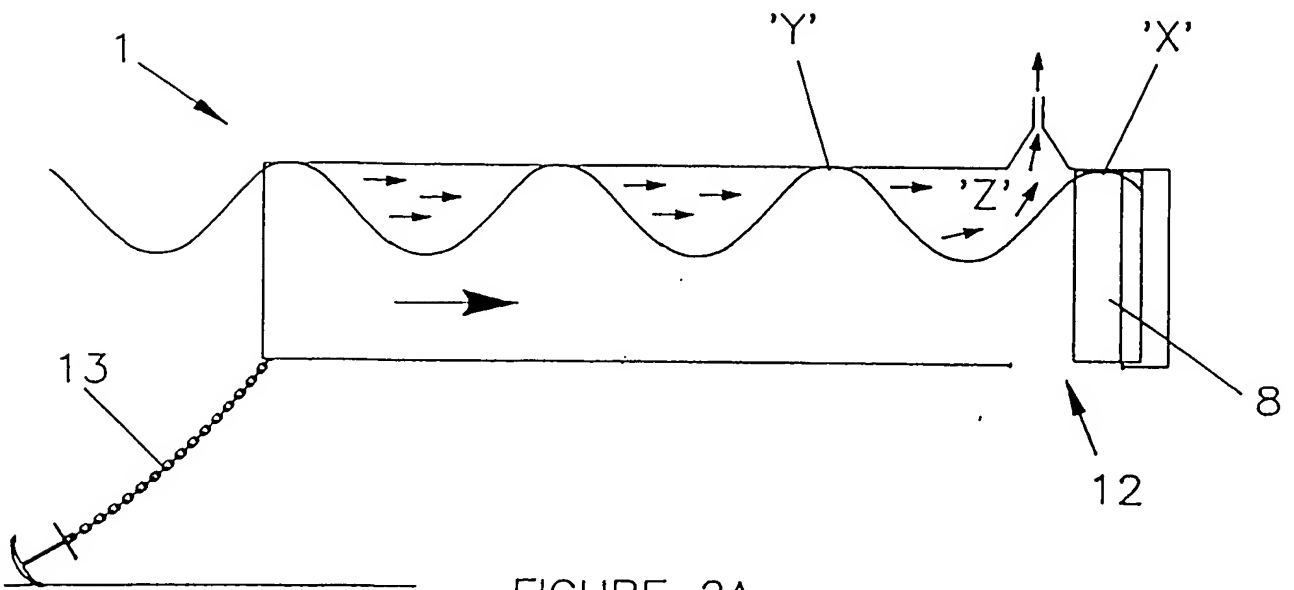
$\frac{1}{2}$ 

FIGURE 1

2/2



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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference P1325 PCT	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 01/ 01012	International filing date (day/month/year) 28/02/2001	(Earliest) Priority Date (day/month/year) 02/03/2000
Applicant KEMP, John, Frederick		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



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the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

1



None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/GB 01/01012

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

Apparatus for deriving energy from waves, comprising a chamber (1) adapted to float in water but having a water plane area such that its vertical oscillating movement is substantially damped relative to the height of waves in the water in which it is floating, a chamber inlet port (5) at one end of the chamber adapted to face into a wavetrain, and vertical side plates (7A, 7B) delivering compressed air to a manifold and hence to an outlet port (9) and a baffle (8).

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/01012

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F03B13/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 685 291 A (FADDEN WILLIAM J JR) 22 August 1972 (1972-08-22) column 4, line 11 - line 19	1-5, 7-9, 13, 14, 16
Y	column 5, line 35 - line 53 figures 2-4	6, 10, 12, 15
Y	DE 38 03 570 A (ZELCK GERD ING GRAD) 28 July 1988 (1988-07-28) column 6, line 10 - line 20 figure 2	6, 15
Y	US 4 036 563 A (TORNKVIST ROLF E A) 19 July 1977 (1977-07-19) column 3, line 65 - column 4, line 12 figure 4	10, 12
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

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O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

G document member of the same patent family

Date of the actual completion of the international search

23 May 2001

Date of mailing of the international search report

08/08/2001

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/01012

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 196 697 A (PASS GRAHAM ROBERT GEORGE) 5 May 1988 (1988-05-05) page 1, line 45 - line 60 page 1, line 112 -page 2, line 21 ----	10,15
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A	US 3 149 776 A (PARRISH) 22 September 1964 (1964-09-22) column 1, line 65 -column 2, line 50 ----	1-16
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Information on patent family members

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